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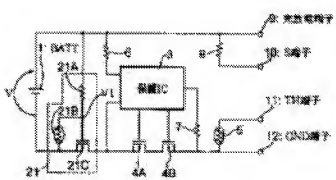
(54) BATTERY PACK TEMPERATURE PROTECTING CIRCUIT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a battery pack temperature protecting circuit, capable of attaining size and weight reduction in a battery pack without causing cost increase in the assembling work.
SOLUTION: A serial resistor circuit, formed by serial-connecting a resistor element 21A having a prescribed resistance value with a thermistor 21B, is parallel-connected with a battery 1 (BATT), and a switching circuit constituted of an FET21C is serially connected with the battery 1. An electric potential V1, obtained by voltage-dividing the voltage V of the batter 1 through the resistor element 21A and the thermistor 21B, is supplied to the gate of the FET21C. When ambient temperature changes, the resistance value of the thermistor 21B is changed, and the electric potential V1 obtained by voltage-dividing the voltage V of the battery 1 through the resistor element 21A and the thermistor 21B changes. As a result, the FET21C is in a cut-off condition, so that a current route of the battery 1 to the outside is shut down.



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the battery pack temperature protecting circuit for protecting a battery pack from abnormal temperature.
[0002]
[Description of the Prior Art]Conventionally, in battery packs, such as a lithium cell, it has the function which detects the rise of excess voltage, an over-current, or temperature, and intercepts a power supply circuit, and the temperature protection element is built in as a power pack temperature protecting circuit for realizing this function.
[0003]The circuitry of this kind of conventional battery pack is shown in drawing 12. A temperature protection element for a rechargeable battery rechargeable in the numerals 1 and the numerals 2 to protect the cell (BATT) 1 from abnormal temperature in the figure, FET and the numerals 5 which protection IC which supervises the excess voltage at the time of charge and the over-current at the time of battery pack use, and the numerals 4A and 4B turn on and off based on the signal from protection IC3 the numerals 3, The resistance element and the numerals 8 attached to protection IC3 the NTC thermistor for making the battery charger to which this battery pack was connected detect abnormal temperature, and the numerals 6 and 7, The switch terminal for which the charge and discharge terminal was connected to the battery charger as for the resistance element for making charge voltages detect and the numerals 9, and the resistance element 9 was connected to the numerals 10, TH terminal for which NTC thermistor 5 was connected to the numerals 11, and the numerals 12 are GND terminals. The above-mentioned charge and discharge terminal 9, the switch terminal 10, the TH terminal 11, and GND terminal 12 form an external battery charger and the connection terminal by the side of a device.
[0004]According to the conventional battery pack provided with this temperature protection element 2, at the usual temperature, the temperature protection element 2 is switch-on, and the anode of the cell 1 is connected to the charge and discharge terminal 9. Unless protection IC3 detects excess voltage and an over-current, FET4A and 4B are made into switch-on, and the negative electrode of the cell 1 is connected with GND terminal 12 via FET4A and 4B. Therefore, in this case, at the time of discharge, in the charge and discharge terminal 9 and GND terminal 12, the potential of the anode of the cell 1 and a negative electrode appears, respectively, and electric power is supplied to an external device. At the time of charge, the potential from an external battery charger is given to the cell 1 via the charge and discharge terminal 9 and GND terminal 12.

[0005]Here, when the cell 1 generates heat by a surcharge or overdischarge and the inside of a battery pack becomes abnormal temperature, the temperature protection element 2 will be in a cut off state, and separates the anode of the cell 1 from the charge and discharge terminal 9. Thereby, as a result of intercepting the current route between an external battery charger and the anode of the cell 1, generation of heat of the cell 1 is controlled and the cell 1 is protected from abnormal temperature.
[0006]
[Problem(s) to be Solved by the Invention]By the way, generally as the temperature protection element 2, a poly switch and a thermal cutout are used. However, the poly switch had heavy weight, and since it was a lead type, when it included this in a battery pack, it needed soldering and welding technique by handicraft. For this reason, the assembly cost of the battery pack became high and, moreover, there was a problem that a small weight saving was difficult.
[0007]Although weight is light a thermal cutout, since it disconnected with abnormal temperature in addition to the problem that it assembles like a poly switch and expense becomes high since it is a lead type, there was a problem that a reuse was not made.
[0008]Let it be SUBJECT to provide the battery pack temperature protecting circuit which enables this invention to carry out the small weight saving of the battery pack moreover, without having been made in view of this situation and causing the rise of assembly expense.
[0009]
[Means for Solving the Problem]In order to carry out solution achievement of the aforementioned problem, this invention has the following composition. Namely, a series resistance circuit which carries out the series connection of a resistance element which multiple connection of the invention concerning Claim 1 is carried out to a cell, and has predetermined resistance, and the thermo sensitive register from which resistance changes according to ambient air temperature, The series connection was carried out to said cell, and it had a switching circuit opened and closed according to potential which appears at a node of said resistance element and a thermo sensitive register.
[0010]According to this invention, resistance of a thermo sensitive register changes according to the surrounding temperature. The partial pressure of the voltage of a cell is carried out by resistance element and a thermo sensitive register, and potential which appears at these nodes is given to a switching circuit. At this time, a switching circuit is opened and closed according to potential which appears at this node. Therefore, when choosing appropriately resistance of a resistance element, the temperature characteristics of a thermo sensitive register, or the operating point of a switching circuit and ambient air temperature exceeds temperature set up beforehand, a switching circuit is made to open wide and it becomes possible to intercept a cell from the outside.
[0011]Said series resistance circuit connected said resistance element to the anode side of said cell, and an invention concerning Claim 2 connected said thermo sensitive register to the negative-electrode side of said cell, and said switching circuit was connected to this cell and series at the negative-electrode side of said cell.
[0012]Said series resistance circuit connected said thermo sensitive register to the anode side of said cell, and an invention concerning Claim 3 connected said resistance element to the negative-electrode side of said cell, and said switching circuit was connected to this cell and series at the negative-electrode side of said cell.
[0013]In an invention concerning Claim 4, said thermo sensitive register has the negative characteristic in which resistance decreases with a rise of temperature. In an invention concerning Claim 5, said

thermo sensitive register has the right characteristic which resistance increases with a rise of temperature.

[0014]According to above-mentioned this invention, if it becomes beyond set-up temperature, it will switch off and a circuit will be intercepted. That is, voltage which appears with a resistance element and a thermo sensitive register at these nodes is adjusted, and if temperature set up beforehand is exceeded using resistance of a thermo sensitive register changing with temperature changes, a switching circuit will become off and will intercept a circuit.

[0015]

[Embodiment of the Invention]Hereafter, the embodiment concerning this invention is described with reference to Drawings. In each figure, identical codes are given to the element shown in drawing 12 concerning the above-mentioned conventional technology, and a common element, and the explanation is omitted suitably.

[0016]The circuitry of the battery pack in which the battery pack temperature protecting circuit 21 concerning this Embodiment 1 was applied to embodiment 1. drawing 1 is shown. In the composition shown in drawing 12 concerning the above-mentioned conventional technology, the battery pack shown in the figure is replaced with the temperature protection element 2, and is provided with the battery pack temperature protecting circuit 21 concerning this invention. This battery pack temperature protecting circuit 21 consists of the resistance element 21A (fixed resistance) which has predetermined resistance, the thermo sensitive register 21B from which resistance changes according to ambient air temperature, and N channel type FET(field effect transistor) 21C, as shown in drawing 2.

[0017]Here, the series connection of the resistance element 21A and the thermo sensitive register 21B of each other is carried out, and they constitute a series resistance circuit. This series resistance circuit is seen from the charge and discharge terminal 9 and GND terminal 12 which are shown in drawing 1, and is connected in parallel to the cell 1 (for example, lithium cell). The resistance element 21A is connected to the anode side of the cell 1, and the thermo sensitive register 21B is connected to the negative-electrode side of the cell 1.

[0018]That is, one end of the resistance element 21A is connected to the anode of the cell 1, and that other end is connected to one end of the thermo sensitive register 21B, and the other end of this thermo sensitive register 21B is connected to the negative electrode of the cell 1. Thereby, the voltage V1 produced by carrying out the partial pressure of the voltage V of the cell 1 (potential difference between the negative electrode of the cell 1 and an anode) with the resistance element 21A and the thermo sensitive register 21B appears at the node of the resistance element 21A and the thermo sensitive register 21B.

[0019]FET21C constitutes the switching circuit opened and closed according to the voltage V1, and is connected in series between GND terminal 12 and the cell 1. That is, one end (sauce) of the current route of FET21C is connected to the negative electrode of the cell 1, the other end (drain) is connected to GND terminal 12 via FET4A and 4B, and the gate is connected at the node of the resistance element 21A and the thermo sensitive register 21B. Here, the thermo sensitive register 21B is a NTC type thermo sensitive register, and it has the negative characteristic that resistance decreases to the rise of ambient air temperature so that it may illustrate to drawing 3.

[0020]Hereafter, operation of the battery pack temperature protecting circuit 21 concerning this Embodiment 1 is explained. For example, if the cell 1 generates heat by a surcharge or overdischarge,

the ambient air temperature of the thermo sensitive register 21B will rise. When the ambient air temperature of the thermo sensitive register 21B changes (rise), in accordance with the characteristic curve shown in drawing 3, the resistance of the thermo sensitive register 21B changes with heat (ambient air temperature) (reduction), and shows the resistance according to ambient air temperature. At this time, the voltage V1 which appears at the node of the resistance element 21A and the thermo sensitive register 21B is computed by the lower type (1), and as shown in drawing 4 mentioned later, it shows the tendency to fall with the rise of ambient air temperature.

[0021]

V1=VxRTH1/(R1+RTH1) ... (1)

However, V is the voltage between the two poles of the cell 1, RTH1 is the resistance of the thermo sensitive register 21B, and R1 is the resistance of the resistance element 21A.

[0022]As a result of giving the voltage V1 given by this formula (1) to the gate of FET21C, the gate voltage of FET21C is adjusted and a flow / non-switch-on of FET21C are controlled. Therefore, the temperature for making between the negative electrode of the cell 1 and GND terminals 12 into a cut off state can be set up by choosing the resistance of the resistance element 21A, the temperature characteristics of the thermo sensitive register 21B, and the gate threshold voltage of FET21C. Hereafter, the temperature which wishes interception between the negative electrode of the cell 1 and GND terminal 12 is described as "preset temperature."

[0023]According to this Embodiment 1, when the resistance element 21A is made into the fixed resistance of 20komega, for example, the voltage V1 has temperature characteristics illustrated to drawing 4. If the gate cut-off voltage (gate threshold voltage) of FET21C is set as about 1V, when ambient air temperature becomes not less than about 90 **, in this example, FET21C will be in an OFF state, so that drawing 4 may show. As a result, between the negative electrode of the cell 1 and GND terminals 12 will be intercepted, the current I1 which was flowing through FET21C till then will not flow, and the cell 1 is protected from abnormal temperature.

[0024]According to the battery pack shown in drawing 1, surveillance for protection IC3 to protect the cell 1 from an over-current or excess voltage is performed, when an over-current and excess voltage occur, protection IC3 makes the transistors 4A and 4B turn off, and the control action for protecting the cell 1 from an over-current or excess voltage is performed. When in addition to this operation the battery pack temperature protecting circuit 21 performs the above-mentioned operation and becomes the temperature beyond a preset value to abnormal temperature, FET21C is made to turn off and a circuit is intercepted.

[0025]As explained above, in this Embodiment 1. By using the characteristic (characteristic shown in drawing 4) which shows the tendency for the voltage V1 to fall according to the rise of ambient air temperature, and choosing the gate cut-off voltage of FET21C according to the voltage V1 at preset temperature, Make FET21C one [in below preset temperature], it is made to turn off in more than preset temperature, the current I1 which flows into the negative electrode of the cell 1 from GND terminal 12 is intercepted, and the cell 1 is protected from abnormal temperature. Therefore, according to this Embodiment 1, it becomes possible to set abnormal temperature to the elevated-temperature side.

[0026]The circuitry of the battery pack in which the battery pack temperature protecting circuit 22 concerning this embodiment of the invention 2 was applied to embodiment 2. drawing 5 is shown. In the composition of the battery pack temperature protecting circuit 21 shown in above-mentioned drawing 1

and drawing 2, the battery pack temperature protecting circuit 22 shown in the figure replaces the resistance element 21A and the thermo sensitive register 21B, and is constituted. In this case, the voltage V2 which appears at the node of the resistance element 21A and the thermo sensitive register 21B is computed by the lower type (2).

[0027]

V2=VxR1/(R1+RTH1) ... (2)

However, V is the voltage between the two poles of the cell 1, RTH1 is the resistance of the thermo sensitive register 21B, and R1 is the resistance of the resistance element 21A.

[0028]Here, if what was used by the above-mentioned Embodiment 1 as the characteristic of the thermo sensitive register 21B and resistance of the resistance element 21A is adopted, the voltage V2 has the characteristic of going up with the rise of ambient air temperature, as shown in drawing 6. If this characteristic is used and the gate cut-off voltage of FET21C is chosen according to preset temperature, will make FET21C one [in more than preset temperature], it will be made to turn off in below preset temperature, and it will become possible from GND terminal 12 to intercept the current I1 which flows into the negative electrode of the cell 1. Therefore, according to this Embodiment 2, it becomes possible to set abnormal temperature to the low temperature side.

[0029]The circuitry of the battery pack in which the battery pack temperature protecting circuit 23 concerning this embodiment of the invention 3 was applied to embodiment 3. drawing 7 is shown. In the composition of the battery pack temperature protecting circuit 21 shown in above-mentioned drawing 1 and drawing 2, this battery pack temperature protecting circuit 23 changes the NTC type thermo sensitive register 21B to the PTC type thermo sensitive register 23B, and is constituted.

[0030]Here, the thermo sensitive register 23B has the positive characteristic which resistance increases near 110 ** with the rise of ambient air temperature so that it may illustrate to drawing 8. In this case, the voltage V3 which appears at the node of the resistance element 21A (20komega) and the thermo sensitive register 23B has the characteristic which shows the tendency which increases near 110 ** with the rise of ambient air temperature, as shown in drawing 9.

[0031]If this characteristic is used and the gate cut-off voltage of FET21C is chosen according to desired temperature, will make FET21C one [in more than preset temperature], it will be made to turn off in below preset temperature, and it will become possible to intercept the current I1 which flows in from GND terminal 12.

[0032]The circuitry of the battery pack in which the battery pack temperature protecting circuit 24 concerning this embodiment of the invention 4 was applied to embodiment 4. drawing 10 is shown. In the composition of the battery pack temperature protecting circuit 23 shown in above-mentioned drawing 7, this battery pack temperature protecting circuit 24 replaces the resistance element 21A and the PTC type thermo sensitive register 23B, and is constituted.

[0033]In this case, the voltage V4 which appears at the node of the resistance element 21A and the thermo sensitive register 23B has the characteristic which shows the tendency which decreases near 110 ** with the rise of ambient air temperature, as shown in drawing 11. If this characteristic is used and the gate cut-off voltage of FET21C is chosen according to preset temperature, will make FET21C one [in below preset temperature], it will be made to turn off in more than preset temperature, and it will become possible to intercept the current I1 which flows in from GND terminal 12.

[0034]According to each above-mentioned embodiment, each part article which constitutes a battery

pack temperature protecting circuit has a small light weight, since it is moreover a surface mounted device, the small weight saving of a battery pack and automatic loading are attained, and a manufacturing cost is also reduced.

[0035]As mentioned above, although this embodiment of the invention was described, this invention is not restricted to this embodiment, and even if the design variation etc. of the range which does not deviate from the gist of this invention occur, it is included in this invention. For example, although FET21C shall be provided between the negative electrode of the cell 1, and GND terminal 12 and between the negative electrode of the cell 1 and GND terminals 12 shall be intercepted in each above-mentioned embodiment, It is also possible to provide P channel type FET between the anode of the cell 1 and the charge and discharge terminal 9, and to intercept between the anode of the cell 1 and the charge and discharge terminals 9.

[0036]

[Effect of the Invention]According to this invention, the following effects can be acquired as explained above. Namely, the series connection of the resistance element which has predetermined resistance, and the thermo sensitive register from which resistance changes according to ambient air temperature is carried out, Multiple connection of these is carried out to a cell, and the series connection of the switching circuit is carried out to said cell, and since said switching circuit was opened and closed according to the potential which appears at the node of said resistance element and a thermo sensitive register, it becomes possible to carry out the small weight saving of the battery pack, without causing the increase in assembly expense.

[Translation done.]

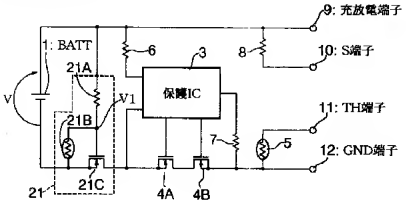
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a circuit diagram of the battery pack concerning this embodiment of the invention 1.
[Drawing 2]It is a circuit diagram of the battery pack temperature protecting circuit concerning this embodiment of the invention 1.
[Drawing 3]It is a characteristic figure showing the temperature dependence of the resistance of the thermo sensitive register (NTC type) concerning this embodiment of the invention 1.
[Drawing 4]It is a characteristic figure showing the temperature dependence of the voltage V1 in the series resistance circuit concerning this embodiment of the invention 1.
[Drawing 5]It is a circuit diagram of the battery pack concerning this embodiment of the invention 2.
[Drawing 6]It is a characteristic figure showing the temperature dependence of the voltage V2 in the series resistance circuit concerning this embodiment of the invention 2.
[Drawing 7]It is a circuit diagram of the battery pack concerning this embodiment of the invention 3.
[Drawing 8]It is a characteristic figure showing the temperature dependence of the resistance of the thermo sensitive register (PTC type) concerning this embodiment of the invention 3.
[Drawing 9]It is a characteristic figure showing the temperature dependence of the voltage V3 in the series resistance circuit concerning this embodiment of the invention 3.
[Drawing 10]It is a circuit diagram of the battery pack concerning this embodiment of the invention 4.
[Drawing 11]It is a characteristic figure showing the temperature dependence of the voltage V4 in the series resistance circuit concerning this embodiment of the invention 4.
[Drawing 12]It is a circuit diagram of the battery pack concerning conventional technology.
[Description of Notations]
1 -- A cell (BATT), 21-24 -- A battery pack temperature protecting circuit, 21A, 6-8 -- Resistance element, 21B [-- A thermo sensitive register, 9 / -- A charge and discharge terminal, 10 / -- A switch terminal, 11 / -- TH terminal, 12 / -- GND terminal.] -- A thermo sensitive register (NTC type), 21C and 4A, 4 B--FET (N channel type), 23B -- A thermo sensitive register (PTC type), 3 -- Protection IC, 5

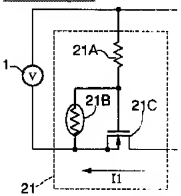
[Translation done.]

DRAWINGS

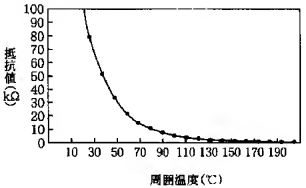
[Drawing 1]



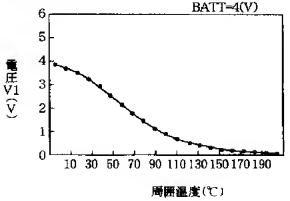
[Drawing 2]



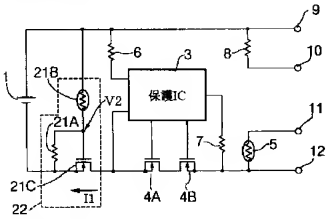
[Drawing 3]



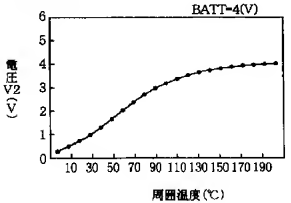
[Drawing 4]



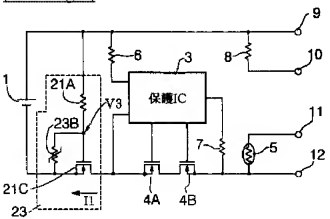
[Drawing 5]



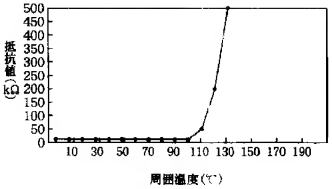
[Drawing 6]



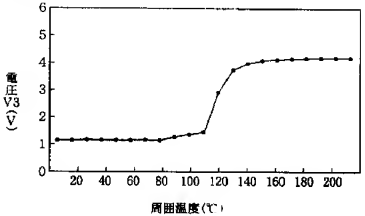
[Drawing 7]



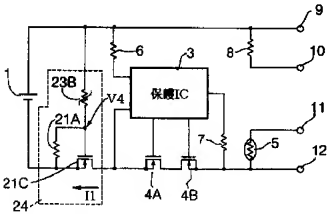
[Drawing 8]



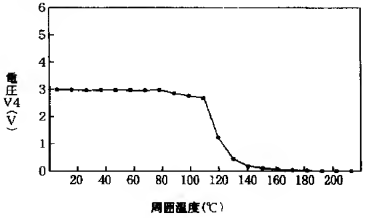
[Drawing 9]



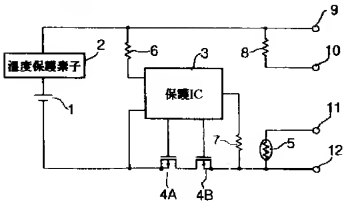
[Drawing 10]



[Drawing 11]



[Drawing 12]



WRITTEN AMENDMENT

[Written Amendment]
[Filing date]Heisei 11(1999) November 18 (1999.11.18)
[Amendment 1]
[Document to be Amended]Description
[Item(s) to be Amended]Claims
[Method of Amendment]Change
[Proposed Amendment]
[Claim(s)]
[Claim 1]A series resistance circuit which carries out the series connection of a resistance element which multiple connection is carried out to a cell and has predetermined resistance, and the thermo sensitive register from which resistance changes according to ambient air temperature,
A switching circuit which consists of a field effect transistor opened according to potential which appears at a node of said resistance element and a thermo sensitive register when a series connection is carried out to said cell, and a gate is connected at a node of said resistance element and a thermo sensitive register and said ambient air temperature exceeds temperature set up beforehand,
A battery pack temperature protecting circuit characterized by preparation ******.
[Claim 2]Said series resistance circuit,
Said resistance element is connected to the anode side of said cell, and said thermo sensitive register is connected to the negative-electrode side of said cell,
A battery pack temperature protecting circuit indicated to Claim 1, wherein said switching circuit is connected to the negative-electrode side of said cell at this cell and series.
[Claim 3]Said series resistance circuit,
Said thermo sensitive register is connected to the anode side of said cell, and said resistance element is connected to the negative-electrode side of said cell,
A battery pack temperature protecting circuit indicated to Claim 1, wherein said switching circuit is connected to the negative-electrode side of said cell at this cell and series.
[Claim 4]A battery pack temperature protecting circuit indicated to Claim 2, wherein said thermo sensitive register has the negative characteristic in which resistance decreases with a rise of temperature, or either of 3.
[Claim 5]A battery pack temperature protecting circuit indicated to Claim 2, wherein said thermo sensitive register has the right characteristic which resistance increases with a rise of temperature, or either of 3.
[Amendment 2]
[Document to be Amended]Description
[Item(s) to be Amended]0009
[Method of Amendment]Change
[Proposed Amendment]
[0009]
[Means for Solving the Problem]In order to carry out solution achievement of the aforementioned problem, this invention has the following composition. Namely, a series resistance circuit which carries

out the series connection of a resistance element which multiple connection of the invention concerning Claim 1 is carried out to a cell, and has predetermined resistance, and the thermo sensitive register from which resistance changes according to ambient air temperature, A series connection is carried out to said cell, and a gate is connected at a node of said resistance element and a thermo sensitive register, When said ambient air temperature exceeded temperature set up beforehand, it had a switching circuit which consists of a field effect transistor opened according to potential which appears at a node of said resistance element and a thermo sensitive register.